

Neuromorphic Computing

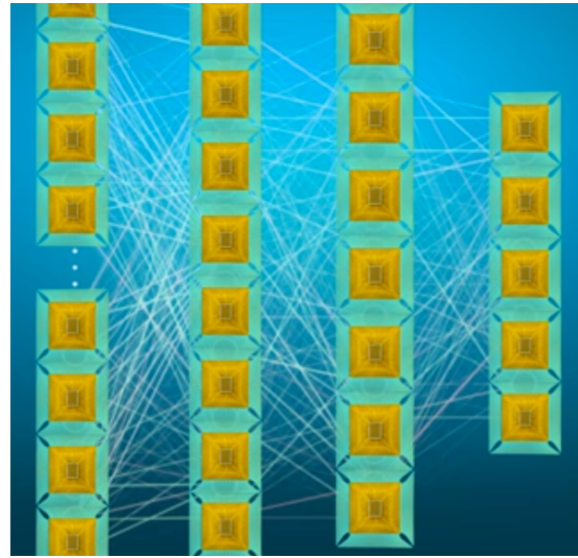
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Neuromorphic Computing

- Type of biologically-inspired computing technology
- Devices that mimic the natural biological structures of our nervous system
- Asynchronous processor
 - Event driven
- Memory and processing are tightly coupled
- Where Von Neumann architecture can be considered “left brain”, Neuromorphic architectures are “right brain”

Brain-Inspired Architecture

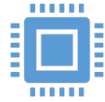
- Neurosynaptic cores tightly couple memory and computation
- Take the place of nodes in machine learning software
- Synapses and connections are continually modified



Challenges

- Vastly different architecture than Von Neumann requires different development
- Reducing the energy-consumption of transistor-based interconnects
- Lack of suitable algorithms
- Interdisciplinary collaboration and skills required

TrueNorth & Loihi



TrueNorth - IBM

1 million neurons
256 million synapses
70 mW power draw



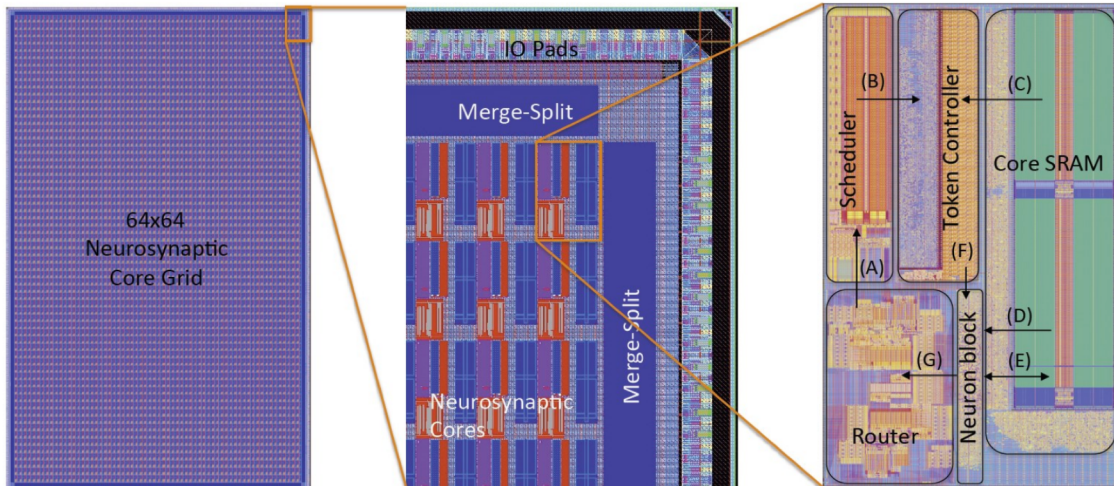
Loihi - Intel

130,000 neurons
130 million synapses



Human Brain

10^{11} neurons
 10^{14} synapses
20W of power



Future Innovations

- SpiNNaker
- Memristors
- Brain simulation
- Integrating neuromorphic and Von Neumann architectures

Sources

- <https://www.youtube.com/watch?v=c-stmgiXCZA>
- <https://www.ibm.com/blogs/research/2016/12/the-brains-architecture-efficiency-on-a-chip/>
- <https://www.nature.com/articles/s41467-019-12521-x>
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- <https://pdfs.semanticscholar.org/4450/05167bef3cf7050b72fca805ba7032d37bfb.pdf>

Questions?